



Emission Calculation Fact Sheet

Michigan Department Of Environmental Quality ♦ Environmental Science And Services Division ♦ (800) 662-9278

FOUNDRIES

This document lists Source Classification Codes (SCC) and emission factors for various activities at foundries. They are provided as an aid in calculating emissions. The emission factors were obtained from the Factor Information Retrieval (FIRE) Data System, Version 6.23 and 6.24 or the U.S. Environmental Protection Agency's (EPA) *Compilation of Air Pollutant Emission Factors (AP-42)*. Both are available on the Internet at www.epa.gov/ttn/chief/index.html.

Note: *These emission factors only address criteria air pollutants. Toxic and hazardous air pollutant (HAP) emissions should also be calculated for compliance with Title V Permits, State Toxic Emission Rules, and applicable federal MACT Standards.*

While the emission factors contained in this fact sheet are acceptable for the purpose of MAERS reporting, stack testing or some other emission calculation method may be required to determine compliance with applicable state and federal rules. If a facility disagrees with any emission factor in this document, it may use other emission factors or another method of calculating emissions providing the emission factor or method correctly characterizes the processes at the facility and the resulting emissions. A facility doing so must submit calculations and documentation showing the source of the factors or method used and justification for their use.

Control Factors

The listed emission factors are for uncontrolled emissions. If a facility has control equipment, such as a scrubber, the emissions can be multiplied by the control factor. Calculate the control factor by subtracting the percent control efficiency from 100 and then divide that number by 100. For example, if the control efficiency is 87%, the control factor would be $(100 - 87)/100 = 0.13$. The control efficiency depends on the capture efficiency of the ductwork leading to the control device and the removal or collection efficiency of the control device.

For most control systems, the ductwork leading to the control device captures a high proportion of the emissions present in the gas stream to be exhausted. If significant emissions escape ahead of the control device, a correction should be applied to the overall control efficiency of the process. For example, if 10% of the emissions in a gaseous stream were lost through leaks ahead of the control device, the process would then have a capture efficiency of 90%.

Overall particulate control efficiency is calculated by multiplying the capture efficiency by the control efficiency. A system with a capture efficiency of 90% and a removal efficiency of 95% has a net control efficiency of 85.5%. $(0.90 \times 0.95 = 0.855)$

Scientific Notation

The emission factors are expressed in scientific notation, which means that the decimal point has been moved. If the exponent is negative, move the decimal point to the left. If the exponent is positive, move the decimal point to the right. If the exponent is zero, the decimal point does not move. For example, if a number is expressed as $2.0E-1$, move the decimal point one place to the left to get 0.20. If a number is expressed as $2.0E2$, move the decimal point 2 places to the right to get 200. If a number is expressed as $2.0E0$, the decimal point does not move – the number is 2.0.

Pollution Prevention

A pollution prevention program is helpful to determine where additional controls may be cost-effective. To begin, conduct an inventory of the current sources, controls, and emissions as a baseline. Once processes with emissions are identified, identify if material substitutions can be made to reduce emissions. Reduction of emissions may be achieved by changing the material used in certain foundry processes, by selecting different sand binders, or by removing materials before processing such as pre-cleaning scrap before charging in the melt furnace.

Reductions may also be achieved by researching, designing, and implementing control method improvements. Reduce fugitive emissions from sources with control equipment by modifying the ductwork to provide better capture efficiency. Consider controls for currently uncontrolled processes. Establish malfunction detection and response plans to minimize unexpected emission increases and consider back-up controls instead of shutting down operations.

The following process changes and innovative control technologies may also reduce emissions:

- Use clean scrap in house or return ingots to reduce HAP emission rates.
- Increase the flux frequency (e.g., instead of fluxing 20 pounds of material at once, do four (4) five pound fluxes over one hour period).
- Use insulated coatings on sand molds/facings to reduce emissions and improve release/cleaning.
- Improve cupola charge door indraft to improve capture and control.
- Modify furnace hood and rim vents to increase the capture efficiency.
- Reduce emission rates through recuperative regeneration.
- Reduce the percentage of binder in mold/core sand.
- Reclaim sand.

GRAY IRON FOUNDRIES

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
Charging			
3-04-003-15	Charging	PM ₁₀ ,FLTRBLE PM,PRIMARY*	3.6E-1 LB/TON IRON 6.0E-1 LB/TON IRON
Melting			
3-04-003-01	Cupola	CO LEAD NOX PM ₁₀ ,FLTRBLE PM _{2.5} ,FLTRBLE PM,PRIMARY* SOX VOC	1.45E2 LB/TON IRON 6.0E-1 LB/TON IRON 1.0E-1 LB/TON IRON 1.24E1 LB/TON IRON 1.16E1 LB/TON IRON 1.38E1 LB/TON IRON 1.25E0 LB/TON IRON 1.8E-1 LB/TON IRON
3-04-003-03	Electric Induction	LEAD PM ₁₀ ,FLTRBLE PM,PRIMARY*	5.45E-2 LB/TON IRON 8.6E-1 LB/TON IRON 9.0E-1 LB/TON IRON
3-04-003-04	Electric Arc	CO NOX PM ₁₀ ,FLTRBLE PM,PRIMARY* SOX VOC	1.9E1 LB/TON IRON 3.2E-1 LB/TON IRON 1.16E1 LB/TON IRON 1.27E1 LB/TON IRON 2.4E-1 LB/TON IRON 1.8E-1 LB/TON IRON
3-04-003-02	Reverberatory	NOX LEAD PM ₁₀ ,FLTRBLE PM,PRIMARY* VOC	5.8E0 LB/TON IRON 7.6E-2 LB/TON IRON 1.7E0 LB/TON IRON 2.1E0 LB/TON IRON 1.5E-1 LB/TON IRON
Inoculation			
3-04-003-10	Inoculation	PM,FLTRBLE VOC	4.0E0 LB/TON IRON 5.0E-3 LB/TON IRON
Pour & Cool (sand mold systems only)			
3-04-003-18	Pouring, Cooling	PM ₁₀ ,FLTRBLE PM _{2.5} ,FLTRBL PM,PRIMARY*	2.06E0 LB/TON GRAY IRON 1.0E0 LB/TON GRAY IRON 4.2E0 LB/TON GRAY IRON
3-04-003-20	Pouring	NOX PM ₁₀ ,FLTRBLE PM,FLTRBLE* SOX VOC	1.0E-2 LB/TON IRON 2.06E0 LB/TON IRON 4.2E0 LB/TON IRON 2.0E-2 LB/TON IRON 1.4E-1 LB/TON IRON
3-04-003-25	Cooling	PM ₁₀ ,FLTRBLE	1.4E0 LB/TON IRON
Core/Mold Making (When using these emission factors in MAERS, list "Other" as the emission basis on the E-101 Form instead of "MAERS Emission Factor" and submit the calculations to the appropriate Air Quality Division district office.)			
3-04-003-19	Core Making, Baking	PM,PRIMARY	1.1E0 LB/TON GRAY IRON
3-04-003-30	Cast Fabrication – Core/mold making <ul style="list-style-type: none"> Phenolic urethane cold box Phenolic urethane no-bake 	VOC VOC	6.5E-1 LB/TON SAND (see note above) 1.17E0 LB/TON SAND (see note above)

*You do not have to report PM,FLTRBLE and PM,PRIMARY emissions in MAERS. These factors are provided for other emission calculation purposes (e.g., demonstrating compliance with state rules).

GRAY IRON FOUNDRIES (continued)

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
Shakeout (sand mold systems only)			
3-04-003-31	Shakeout	PM10,FLTRBLE PM2.5,FLTRBL PM,PRIMARY * VOC	2.24E0 LB/TON IRON 1.34E0 LB/TON IRON 3.2E0 LB/TON IRON 1.2E0 LB/TON IRON
3-04-003-32	Knockout	VOC	1.2E0 LB/TON SAND
3-04-003-33	Shakeout Machine	VOC	1.2E0 LB/TON SAND
Finishing Operation			
3-04-003-40	Grinding/Cleaning	PM10,FLTRBLE	1.7E0 LB/TON IRON
3-04-003-60	Castings Finishing	PM10,FLTRBLE	4.5E-3 LB/TON IRON
Annealing Operations			
3-04-003-05	Annealing	NOX VOC	1.0E0 LB/TON IRON 1.0E-1 LB/TON IRON
Sand Handling			
3-04-003-50	Sand Grinding/Handling	PM10,FLTRBLE PM,PRIMARY*	5.4E-1 LB/TON SAND 3.6E0 LB/TON SAND
3-04-003-52	Sand Grinding/Handling	PM10,FLTRBLE	6.0E0 LB/TON IRON
Mold/Core Processes			
3-04-003-51	Core Oven	NOX PM10,FLTRBLE SOX	5.0E-1 LB/TON SAND 2.22E0 LB/TON SAND 3.8E-2 LB/TON SAND
3-04-003-53	Core Oven	NOX PM10,FLTRBLE	5.0E-1 LB/TON METAL 9.0E-1 LB/TON METAL
3-04-003-54	Core Oven	NOX	5.0E-1 LB/GAL CORE OIL
3-04-003-70	Shell Core Machine	NOX SOX	5.0E-1 LB/TON CORE 3.2E-1 LB/TON CORE
3-04-003-71	Core Machines/Other	NOX	5.0E-1 LB/TON CORE
Treatment			
3-04-003-21	Magnesium Treatment	PM,PRIMARY	1.8E0 LB/TON GRAY IRON
Refining			
3-04-003-22	Refining	PM,PRIMARY	4.0E0 LB/TON GRAY IRON

*You do not have to report PM,PRIMARY emissions in MAERS. This factor is provided for other emission calculation purposes (e.g., demonstrating compliance with state rules).

STEEL FOUNDRIES

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
Charging			
3-04-007-12	Charge Handling	PM10,FLTRBLE	3.6E-1 LB/TON IRON
Melting Operations			
3-04-007-01	Electric Arc	NOX PM,FLTRBLE SOX VOC	2.0E-1 LB/TON IRON 1.3E1 LB/TON IRON 2.4E-1 LB/TON IRON 3.5E-1 LB/TON IRON
3-04-007-02	Open Hearth	NOX PM,FLTRBLE VOC	1.0E-2 LB/TON METAL 1.1E1 LB/TON METAL 1.7E-1 LB/TON METAL
3-04-007-03	Open Hearth with Oxygen Lance	PM10,FLTRBLE PM,FLTRBLE* VOC	8.5E0 LB/TON METAL 1.0E1 LB/TON METAL 1.7E-1 LB/TON METAL
3-04-007-04	Heat Treating	NOX SOX VOC	8.07E1 LB/TON IRON 2.77E2 LB/TON IRON 6.0E-1 LB/TON IRON
3-04-007-05	Electric Induction	PM10,FLTRBLE PM,FLTRBLE*	9.0E-2 LB/TON IRON 1.0E-2 LB/TON IRON
Pour & Cool (sand mold systems only)			
3-04-007-08	Pouring	NOX PM10,FLTRBLE PM,FLTRBLE* SOX VOC	1.0E-2 LB/TON IRON 2.8E0 LB/TON IRON 2.8E0 LB/TON IRON 2.0E-2 LB/TON IRON 1.4E-1 LB/TON IRON
3-04-007-13	Cooling	PM10,FLTRBLE PM,FLTRBLE*	1.4E0 LB/TON IRON 1.4E0 LB/TON IRON
Shakeout (sand mold systems only)			
3-04-007-09	Casting Shakeout	PM10,FLTRBLE VOC	2.62E1 LB/TON IRON 1.2E0 LB/TON IRON
3-04-007-10	Casting Knockout	VOC	1.2E0 LB/TON SAND
3-04-007-14	Shakeout Machine	VOC	1.2E0 LB/TON SAND
Finishing Operation			
3-04-007-11	Grinding/Cleaning	PM10,FLTRBLE	1.7E0 LB/TON IRON
3-04-007-15	Finishing	PM10,FLTRBLE SOX VOC	4.5E-3 LB/TON IRON 4.77E1 LB/TON IRON 1.1E0 LB/TON IRON

*You do not have to report PM,FLTRBLE emissions in MAERS. This factor is provided for other emission calculation purposes (e.g., demonstrating compliance with state rules).

STEEL FOUNDRIES (continued)

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
Sand Handling			
3-04-007-06	Sand Grinding/Handling	PM10,FLTRBLE	5.4E-1 LB/TON SAND
3-04-007-16	Sand Grinding/Handling	PM10,FLTRBLE	6.0E0 LB/TON IRON
Mold/Core Processes			
3-04-007-07	Core Oven	PM10,FLTRBLE	2.22E0 LB/TON SAND
3-04-007-17	Core Oven	NOX PM10,FLTRBLE	5.0E-1 LB/TON IRON 9.0E-1 LB/TON IRON
3-04-007-18	Core Oven	NOX	5.0E-1 LB/GAL CORE OIL
3-04-007-30	Shell Core Machine	NOX	5.0E-1 LB/TON CORE
3-04-007-31	Core Machines/Other	NOX	5.0E-1 LB/TON CORE

SECONDARY ALUMINUM PRODUCTION

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
3-04-001-01	Sweating furnace	PM10,FLTRBLE PM,FLTRBLE* SOX	1.33E1 LB/TON ALUMINUM 1.45E1 LB/TON ALUMINUM 2.0E-2 LB/TON ALUMINUM
3-04-001-02	Smelting furnace/crucible	PM10,FLTRBLE PM,FLTRBLE*	1.7E0 LB/TON ALUMINUM 1.9E0 LB/TON ALUMINUM
3-04-001-03	Smelting furnace/reverberatory	PM10,FLTRBLE PM2.5,FLTRBL PM,FLTRBLE* VOC	2.6E0 LB/TON ALUMINUM 2.16E0 LB/TON ALUMINUM 4.3E0 LB/TON ALUMINUM 2.0E-1 LB/TON ALUMINUM
3-04-001-04	Fluxing: chlorination	PM10,FLTRBLE PM2.5,FLTRBL PM,FLTRBLE*	5.32E2 LB/TON CHLORINE 1.99E2 LB/TON CHLORINE 1.0E3 LB/TON CHLORINE
3-04-001-09	Burning/drying	LEAD NOX SOX	2.16E-2 LB/TON ALUMINUM 9.0E-1 LB/TON ALUMINUM 2.9E0 LB/TON ALUMINUM
3-04-001-11	Foil converting	VOC	2.4E0 LB/TON ALUMINUM
3-04-001-14	Pouring/Casting	NOX SOX VOC	1.0E-2 LB/TON ALUMINUM 2.0E-2 LB/TON ALUMINUM 1.4E-1 LB/TON ALUMINUM
3-04-001-20	Can manufacture	NOX	7.0E-1 LB/TON MATERIAL

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SECONDARY COPPER PRODUCTION

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
3-04-002-04	Electric induction furnace	PM,FLTRBLE	2.0E1 LB/TON CHARGE
3-04-002-07	Scrap dryer (rotary)	PM10,FLTRBLE	2.53E2 LB/TON CHARGE
3-04-002-08	Wire burning: incinerator	PM10,FLTRBLE SOX VOC	2.53E2 LB/TON CHARGE 1.28E1 LB/TON CHARGE 6.0E-1 LB/TON CHARGE
3-04-002-10	Cupolas – charge w/ scrap copper	PM10,FLTRBLE PM,FLTRBLE* VOC	2.7E-4 LB/TON CHARGE 3.0E-4 LB/TON CHARGE 1.8E-1 LB/TON CHARGE
3-04-002-11	Cupolas – charge w/ insulated copper wire	PM10,FLTRBLE PM, PRIMARY* VOC	2.116E2 LB/TON CHARGE 2.3E2 LB/TON CHARGE 6.0E-1 LB/TON CHARGE
3-04-002-12	Cupolas – charge w/ scrap copper and brass	PM10,FLTRBLE PM,PRIMARY* VOC	6.44E1 LB/TON CHARGE 7.0E1 LB/TON CHARGE 1.8E-1 LB/TON CHARGE
3-04-002-13	Cupolas – charge w/ scrap iron	PM,PRIMARY	3.0E-3 LB/TON CHARGE
3-04-002-14	Reverberatory furnace – charge w/ copper	PM10,FLTRBLE PM,PRIMARY* VOC	5.1E0 LB/TON CHARGE 5.1E0 LB/TON CHARGE 2.0E-1 LB/TON CHARGE
3-04-002-15	Reverberatory furnace – charge w/ brass and bronze	PM10,FLTRBLE PM,PRIMARY* VOC	2.12E1 LB/TON CHARGE 3.6E1 LB/TON CHARGE 2.0E-1 LB/TON CHARGE
3-04-002-17	Rotary furnace – charge w/ brass and bronze	PM10,FLTRBLE PM,PRIMARY* VOC	1.77E2 LB/TON CHARGE 3.0E2 LB/TON CHARGE 2.4E0 LB/TON CHARGE
3-04-002-19	Crucible & pot furnace – charge w/ brass and bronze	PM10,FLTRBLE PM,PRIMARY* SOX	1.24E1 LB/TON CHARGE 2.1E1 LB/TON CHARGE 5.0E-1 LB/TON CHARGE
3-04-002-20	Electric arc furnace – charge w/ copper	PM10,FLTRBLE PM,PRIMARY*	5.0E0 LB/TON CHARGE 5.0E0 LB/TON CHARGE
3-04-002-21	Electric arc furnace – charge w/ brass and bronze	PM10,FLTRBLE PM,PRIMARY*	6.5E0 LB/TON CHARGE 1.1E1 LB/TON CHARGE
3-04-002-23	Electric induction – charge w/ copper	PM10,FLTRBLE PM,PRIMARY*	7.0E0 LB/TON CHARGE 7.0E0 LB/TON CHARGE
3-04-002-24	Electric induction – charge w/ brass and bronze	PM10,FLTRBLE PM,PRIMARY*	2.0E1 LB/TON CHARGE 2.0E1 LB/TON CHARGE
3-04-002-31	Fugitive emissions – scrap dryer	PM10,FLTRBLE	8.2E0 LB/TON CHARGE
3-04-002-32	Fugitive emissions – wire incinerator	PM10,FLTRBLE	8.2E0 LB/TON CHARGE

*You do not have to report PM,FLTRBLE and PM,PRIMARY emissions in MAERS. These factors are provided for other emission calculation purposes (e.g., demonstrating compliance with state rules).

SECONDARY COPPER PRODUCTION (continued)

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
3-04-002-33	Fugitive emissions – sweating furnace	PM10,FLTRBLE	4.5E-1 LB/TON CHARGE
3-04-002-34	Fugitive emissions – cupola furnace	PM10,FLTRBLE	2.2E0 LB/TON CHARGE
3-04-002-35	Fugitive emissions – reverberatory furnace	PM10,FLTRBLE	3.1E0 LB/TON CHARGE
3-04-002-36	Fugitive emissions – rotary furnace	PM10,FLTRBLE	2.6E0 LB/TON CHARGE
3-04-002-37	Fugitive emissions – crucible furnace	PM10,FLTRBLE	2.9E-1 LB/TON CHARGE
3-04-002-38	Fugitive emissions – electric induction furnace	PM10,FLTRBLE	4.0E-2 LB/TON CHARGE
3-04-002-39	Fugitive emissions – casting operations	PM10,FLTRBLE	1.5E-2 LB/TON CASTING
3-04-002-42	Reverberatory furnace: copper – charge w/ other alloy (7%)	LEAD	5.0E0 LB/TON MATERIAL
3-04-002-43	Reverberatory furnace: copper – charge w/ high yield alloy (58%)	LEAD	5.0E1 LB/TON MATERIAL
3-04-002-44	Reverberatory furnace: copper – charge w/ red yellow brass	LEAD	1.32E1 LB/TON MATERIAL

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